

# NASA SBIR/STTR Technologies

H12.01-9633 - Optical System for Monitoring Net Ocular Blood Flow



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## Identification and Significance of Innovation

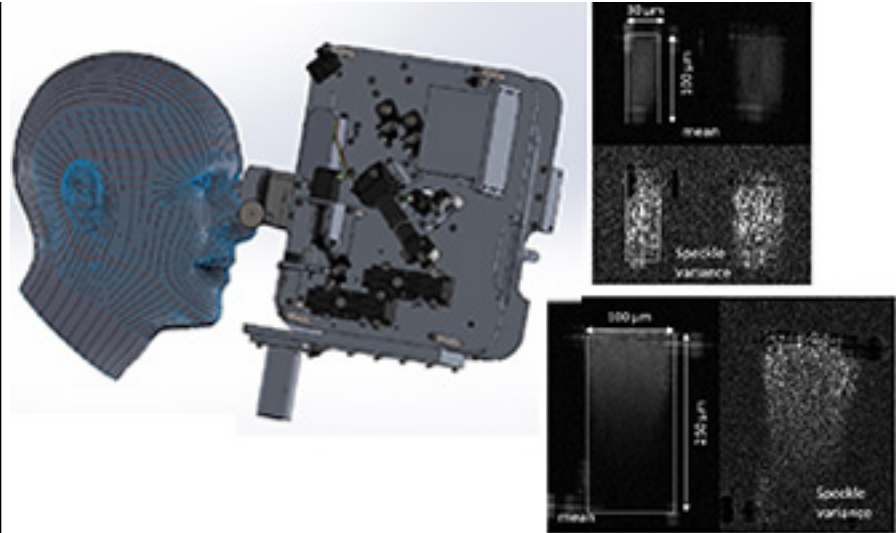
Physical Sciences Inc. (PSI) developed the design for a novel ophthalmic imaging platform for characterization and monitoring of visual impairment observed in long-duration space flights. **We addressed the need for accurate 3D measurement of posterior segment layer thicknesses and volumes, and vascular (retinal and choroidal) topology and flow quantification.** The PSI platform combines non-invasive measurement of retina/choroid structure and ocular blood flow based on Optical Coherence Tomography (OCT) and wide-field semi-quantitative global flow visualization using Line-scanning Doppler Flowmetry (LSDF). Of equal importance for the NASA mission, the multimodal imaging modalities are assembled within a single compact platform. PSI's prior experience in developing advanced ophthalmic imaging systems and space-qualified hardware provides PSI the basis for developing and maturing this single platform that can accommodate imaging studies in animals and human subjects, and will be suitable for future ISS missions.

Estimated TRL at beginning and end of contract: ( Begin: 3 End: 6 )

## Technical Objectives and Work Plan

**PSI has a long and successful history of developing advanced ophthalmic imaging instrumentation and we propose to apply this experience to address NASA needs.** The main objective of the proposed research is the development of an ophthalmic imaging system that can non-invasively and non-mydiatically provide structural (thickness maps and volume) and hemodynamic (net blood flow) characterization of the eye posterior segment (retina and choroid). **PSI proposes to develop a novel multimodal imager based on previous PSI imaging systems combining OCT with LSDF.** OCT will provide 3D structural information and precise local flow parameters while semi-quantitative LSDF flow visualizations will aid in characterizing global blood flow patterns.

The Phase II work plan is divided into seven tasks designed to achieve the program objectives and the overall program goal of developing an ophthalmic imaging system for measuring eye structure and hemodynamics. The tasks also address anticipated technical risks and demonstrate the feasibility of the proposed imaging system. Tasks: 1) Fabricate the Alpha Prototype Eye Imager; 2) Develop Imager Control Software; 3) Develop real-time processing software; 4) Preliminary Testing of the Alpha Prototype Imager on Human Volunteers; 5) Test the Alpha Prototype Imager on Small Animals; 6) Develop Phase III and commercialization plans; 7) Instrument delivery.



## NASA Applications

Changes in intracranial pressure and effects on vision encountered in space exploration missions (VIIP syndrome) have created the need for advanced imaging modalities to monitor these effects, pre and postflight, and potentially in space. Functional and structural alterations including reduction of near visual acuity, optic disc edema, globe flattening with hyperopic shift, choroidal folds and cotton wool spots have been experienced by astronauts in long-duration space travels.

## Non-NASA Applications

The retina is a highly vascularized and metabolically active tissue. Degenerative neurovascular diseases of the eye often have either hemodynamic consequences or causes. Little is known about the ocular and cerebral blood flow during exposure to increasingly hypoxic conditions or hypercapnia. Improved blood flow imaging diagnostics will aid the detection and management of many eye conditions.

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**NON-PROPRIETARY DATA**